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Research Document 2011/070 | **Document de recherche 2011/070**

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Identification of Ecologically and Biologically Significant Areas (EBSAs) in the Canadian Arctic

Identification de zones d'importance écologique et biologique (ZIEB) dans l'Arctique canadien

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ISSN 1499-3848 (Printed / Imprimé)
ISSN 1919-5044 (Online / En ligne)

Canada

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Correct citation for this publication:

Cobb, D.G. 2011. Identification of Ecologically and Biologically Significant Areas (EBSAs) in the Canadian Arctic. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/070. vi + 38 p.

ABSTRACT

In order to facilitate the identification of Arctic Ecologically and Biologically Significant Areas (EBSAs), the Convention on Biological Diversity (CBD) criteria were applied to important areas in the Canadian Arctic. These areas have been previously identified as important in ecosystem overviews, stock status reports, and traditional knowledge studies. A total of 58 candidate EBSAs were identified within five biogeographic areas of the Canadian Arctic (Arctic Basin, Western Arctic, Arctic Archipelago, Eastern Arctic, and Hudson Bay Complex). The results of this analysis formed the basis of a Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS) workshop to review candidate EBSAs, refine boundaries, delete or identify new EBSAs or strengthen arguments in support of EBSAs based on recent information which was presented at the June 2011 CSAS workshop. Important areas were scored as high, medium or low for each of the criteria, and the resultant EBSAs were then ranked.

RÉSUMÉ

Afin d'identifier plus facilement les zones d'importance écologique et biologique (ZIEB) dans l'Arctique, les critères de la Convention sur la diversité biologique (CDB) ont été appliqués aux zones importantes de l'Arctique canadien. Ces zones ont déjà été reconnues comme étant importantes lors d'évaluations écosystémiques, de rapports d'état des stocks et d'études sur le savoir traditionnel. Au total, 58 ZIEB potentielles ont été identifiées dans cinq zones biogéographiques de l'Arctique canadien (bassin arctique, Ouest de l'Arctique, archipel arctique, Est de l'Arctique et complexe de la baie d'Hudson). Les résultats de cette analyse ont servi comme information de base pour l'atelier du Secrétariat canadien de consultation scientifique (SCCS) de Pêches et Océans canada (MPO) visant à étudier les ZIEB potentielles, à en préciser les frontières, à supprimer ou à identifier de nouvelles ZIEB ou à renforcer des arguments en faveur des ZIEB d'après de récentes données présentées à l'atelier du SCCS de juin 2011. L'importance des zones a été classée comme étant élevée, moyenne ou faible selon chaque critère, puis les ZIEB ont ensuite été de nouveau classées.

INTRODUCTION

Canada has committed domestically and internationally to the sustainable development of the Arctic marine environment. The identification of Ecologically and Biologically Significant Areas (EBSAs) in the Canadian Arctic will serve to fulfill Canada's commitments under the Arctic Council's Arctic Marine Shipping Assessment, where it was decided in 2009:

> "*That the Arctic states should identify areas of heightened ecological and cultural significance in light of changing climate conditions and increasing multiple marine use and, where appropriate, should encourage implementation of measures to protect these areas from the impacts of Arctic marine shipping, in coordination with all stakeholders and consistent with international law.*"

The identification of Arctic EBSAs will also be a key component of the knowledge base for: i) the development of the Arctic component of Canada's network of marine protected areas (MPA) and ii) facilitating the implementation of Fisheries and Oceans Canada (DFO) Sustainable Fisheries Framework under the *Fisheries Act*.

The *Oceans Act* (1997) provides the legislative framework for an integrated ecosystem-approach to management in Canadian oceans, particularly in areas considered ecologically or biologically significant. DFO has developed guidance for the identification of EBSAs (DFO 2004), and has endorsed the scientific criteria of the Convention on Biological Diversity (CBD) for identifying ecologically or biologically significant marine areas as defined in Annex I of Decision IX/20 of its 9th Conference of Parties[1].

In order to expedite the work of Arctic EBSA identification, this report used the CBD EBSA criteria to assess areas that have previously been identified under various initiatives and for various applications as being ecologically important (e.g., Mercier et al.1995, Stephenson and Hartwig 2010, Speer and Laughlin 2011). In support of domestic integrated management efforts, EBSAs have already been identified in each of DFO's five Large Ocean Management Areas (LOMA), including the Beaufort Sea in the Canadian Arctic (Paulic et al. 2009). In addition, EBSAs have also been identified in northern Foxe Basin (DFO 2010a). DFO EBSA criteria were applied for both these processes, however, the criteria do align closely with CBD criteria, and as such these areas will not be re-assessed in this report. Contained within is a preliminary set of Arctic EBSAs, with supporting rationale and maps with preliminary EBSA boundaries. This report was the basis of a June 2011 DFO national Canadian Science Advisory Secretariat (CSAS) peer review meeting, the outcome of which will be a preliminary list of Arctic EBSAs based on scientific and traditional knowledge for review. For this report, EBSAs will be identified by applying the CBD criteria in each of the five Canadian Arctic marine biogeographic units as defined by DFO (2009a).

MATERIALS AND METHODS

The five Arctic marine biogeographic units for which EBSAs are being identified are the: Arctic Basin, Western Arctic, Arctic Archipelago, Eastern Arctic, and Hudson Bay Complex (Figure 1). When areas within each of the five biogeographic regions were assessed, smaller scales were sometimes required in order to adequately define the spatial significance of an area by different criteria or layers of information, and also for purposes of displaying the areas on maps. This "nesting" of smaller areas within larger biogeographic areas allows for scaling up or down, depending upon the need, and will ultimately be most beneficial to managers.

[1] http://www.cbd.int/decision/cop/?id=11663

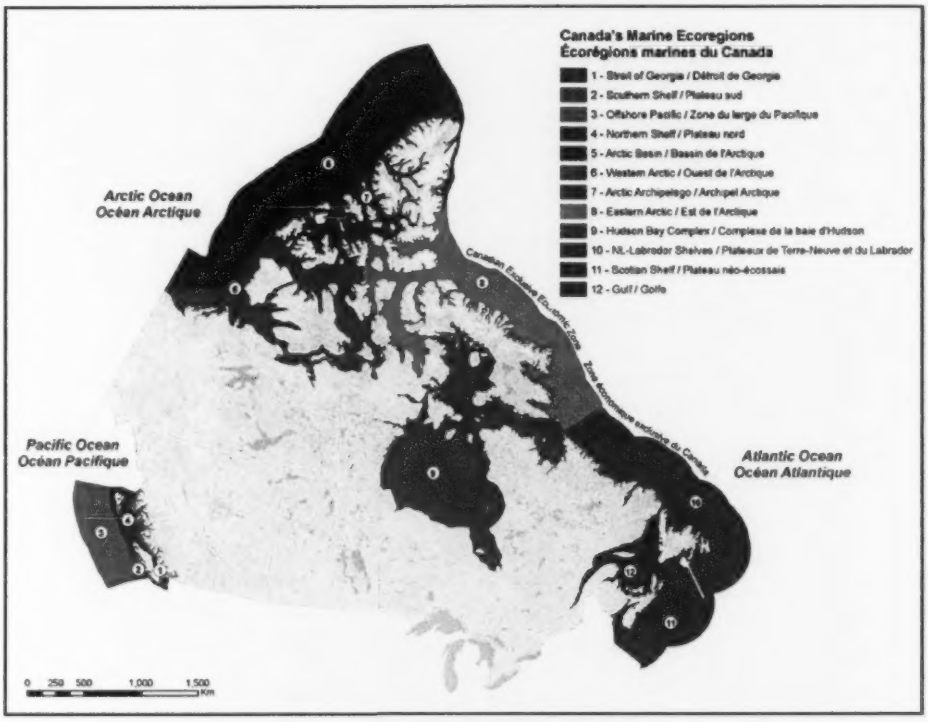

Figure 1. Canada's Marine Biogeographic regions (DFO 2009a).The five Arctic regions that were used for this report are the Arctic Basin (5: dark blue), Western Arctic (6: light blue), Arctic Archipelago (7: red), Eastern Arctic (8: tan), and Hudson Bay Complex (9: green).

EBSA CRITERIA

There are 7 CBD scientific criteria for the identification of EBSAs:

1. uniqueness or rarity;
2. special importance for life history stages of species;
3. importance for threatened, endangered or declining species and/or habitats;
4. vulnerability, fragility, sensitivity or slow recovery;
5. biological productivity;
6. biological diversity; and
7. naturalness.

Guidance on definitions of criteria, rationale, examples and special considerations are contained in Appendix 1.

INFORMATION SOURCES AND LIMITATIONS

Scientific and traditional ecological knowledge (TEK) for the Canadian Arctic has been collected over many decades. A number of key documents have synthesized much of this information in recent years for use in marine planning, community conservation planning, and environmental assessments. Moreover, there have been a number of concerted efforts to catalogue Arctic reports (e.g., Arctic Scientific and Technology Information System (a project of the Arctic Institute of North America at the University of Calgary).

Key sources of information used in the identification of these areas are contained in the list of references, which includes DFO, Parks Canada Agency (PCA) and Environment Canada overviews, workshop proceedings, ecosystem status and trends reports, Species At Risk (SARA) and Committee on the Status of Endangered Wildlife in Canada (COSEWIC) reports, DFO stock status reports, and numerous peer reviewed publications resulting from major Arctic research programs conducted over the decades. This report also benefitted from a previous Arctic experts workshop that identified important Arctic areas in Canada (Mercier et al. 1995), and repeated in 2010 to update our current knowledge on areas of biological importance (Stephenson and Hartwig 2010). The identification of important areas also incorporated TEK, which is called Inuit Qaujimajatuqangit (IQ) in Nunavut, and local experiential knowledge (LEK). Examples of some reports which document Arctic IQ include: Voices from the Bay (McDonald et al. 1997), the final report of the Inuit Bowhead Knowledge Study, Nunavut, Canada (NWMB 2000) and various community conservation plans and coastal resource inventories (GN 2008, 2010).

One of the major challenges in identifying EBSAs in the Arctic results from the fact that most marine mammals, birds and many fish species utilize sea-ice and/or ice-edges at varying degrees during seasonal migrations and for summer and winter aggregations. Thus, inter-annual variation in ice regimes can affect the identification of ecologically important marine spaces. This variability results in large areas being identified as important.

The ubiquity of sea-ice in the Arctic means that polynyas (and coastal leads) are important features in structuring the marine environment. Smith and Rigby (1981), Barber and Massom (2007) and Hannah et al. (2009) provide compilations of most of the recurring polynyas in the Canadian Arctic.

Additionally, we have limited knowledge of marine fish spatial use for many regions in the Arctic; Coad and Reist (2004) have compiled known distribution ranges of Arctic marine fish, but a full analysis of habitat use has not been performed. As such, there were challenges to apply EBSA criteria to this group. In some cases, feeding aggregations by seabirds and marine mammal diet were the best evidence to identify important marine fish areas. In addition, ice associated species like the Arctic Cod (*Boreogadus saida*), although a well-known keystone Arctic species, are still poorly understood and very little is known with respect to areas of aggregation and/or fitness consequences. EBSAs may not be the appropriate tool for ensuring adequate risk adverse management for species with these characteristics.

EBSA IDENTIFICATION AND RANKING

Areas within each biogeographical region were assessed against each of the 7 CBD criteria. Uniqueness and rarity were assigned as high, medium or low relative to other areas within the same biogeographical region or if they were unique or rare nationally or globally. Important life history stages were assigned a high, medium or low score depending upon how the loss of an area would compromise a population or stock. For example the loss of a migratory corridor (i.e., the only available migration route for a species) would rank higher than the loss of a migratory pathway (i.e., one of several options for migration for a species). Species that were listed by SARA or COSEWIC were assigned medium for "*Special Concern*" and high for "*Threatened* or *Endangered*". Some groups (e.g., Polar Bear (*Ursus maritimus*) or under-ice communities) are not listed, but they are considered threatened due to declining habitat. Areas were assigned a score based on the degree of vulnerability and speed of recovery of a species, the fragility and/or sensitivity of habitat to disturbance. Biological productivity was assigned a relative score within each biogeographical region or the whole Canadian Arctic. Diversity of species and habitats criteria were applied within the biogeographical region, with areas containing high

heterogeneity of habitats or high species diversity scoring higher than homogeneous areas. Naturalness was assessed based on the amount of human intervention within the area. Areas that are heavily fished, close to communities, experience a high degree of shipping, frequent research or exploration and industrial development, etc. were assigned a score of low, while medium scores were assigned to areas where infrequent human intervention occurred. Areas of high naturalness were areas where human activities were absent or only rarely occurred. An important area was ranked as low (0), medium (0.25) or high (1) following the method used in Placentia Bay/Grand Banks LOMA (Templeman 2007), for each attribute by the dimension. If an area scored medium or high in any single dimension, it ranked as an EBSA, while an area that received all low rankings did not qualify as an EBSA.

RESULTS

The following sections describe the attributes that contributed to an area being considered important for each sub-region of each biogeographic region. Maps are provided with place names and resultant EBSAs. Table 1 summarizes the criteria that applied to each of the important areas, and the degree to which it applied (high, medium and low) for various species or groups of fauna.

1.0 HUDSON BAY COMPLEX

The water bodies of the Hudson Bay Complex (Figure 2) form a large, relatively shallow inland sea connected to the Atlantic Ocean via the Labrador Sea and to the Arctic Ocean via Fury and Hecla Strait. On the basis of physical and biological oceanography, its eastern boundary is generally recognized as the interface of Hudson Strait and the Labrador Sea. Several key features contribute to the broad range of available habitat within this region. The region is characterized by comparatively high productivity and the capacity to support diverse Arctic and subarctic fauna year-round; it is used seasonally by a number of migratory fishes, marine mammals and seabirds (Stewart and Lockhart 2005). One of the predominant features is the atypical southern extent of Arctic marine water into latitudes associated with both Hudson and James bays which enable Arctic fauna (e.g., Walrus (*Odobenus rosmarus rosmarus*), Polar Bear and Beluga (*Delphinapterus leucas*)) to exploit habitats that are well beyond their normal southern range. Secondly, there is a disproportionately large volume of freshwater that enters the ecosystem from overland runoff. The Hudson Bay watershed is larger than that of the Mackenzie and St. Lawrence rivers combined, and its average annual discharge rate (20,700 m^3/s) is double that of these two major rivers (Prinsenberg 1988). A third feature of this region is the relatively shallow depths.

For the purposes of describing areas and applying the EBSA criteria at an appropriate scale, three sub-regions of the Hudson Bay Complex were defined: 1) Foxe Basin, 2) Hudson and James bays, and 3) Hudson Strait (Figure 2). A total of 12 EBSAs were identified within the Hudson Bay Complex biogeographic region (Figure 3).

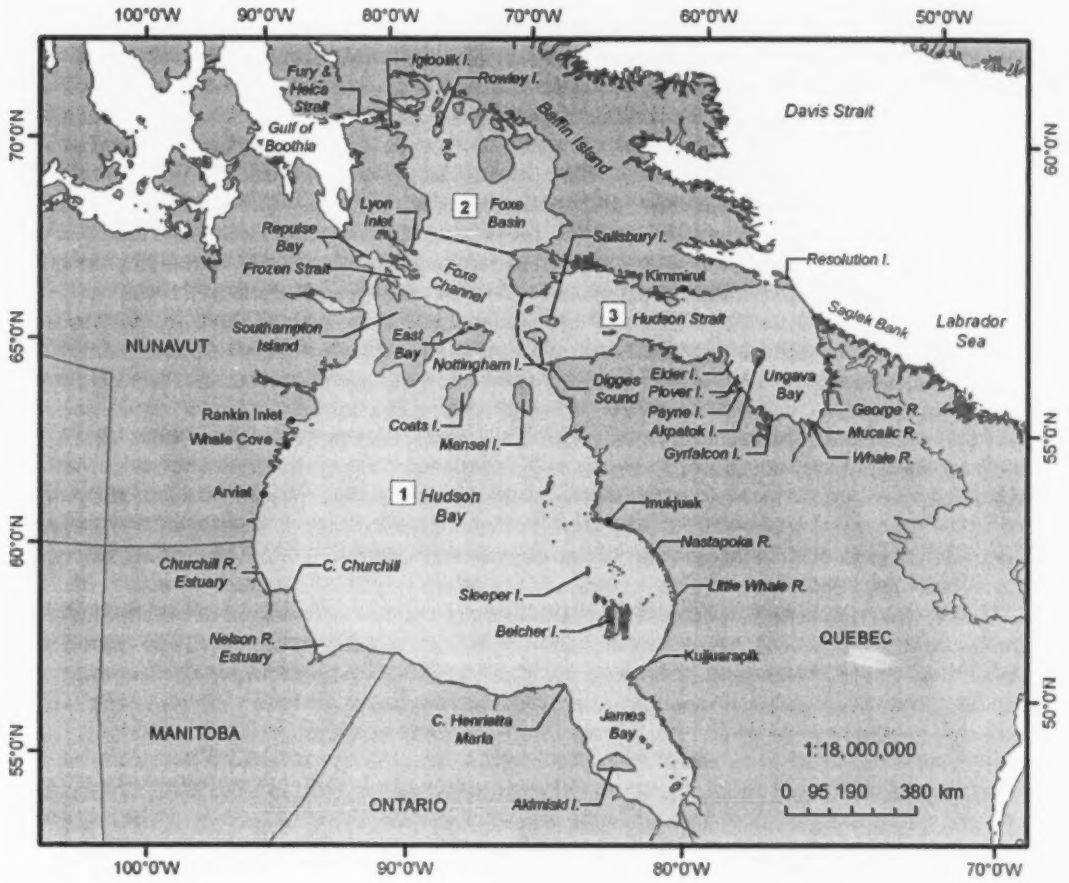

Figure 2. Hudson Bay Complex biogeographic region (green shading) divided into three sub-regions for EBSA evaluation: 1) Hudson and James bays, 2) Foxe Basin and 3) Hudson Strait.

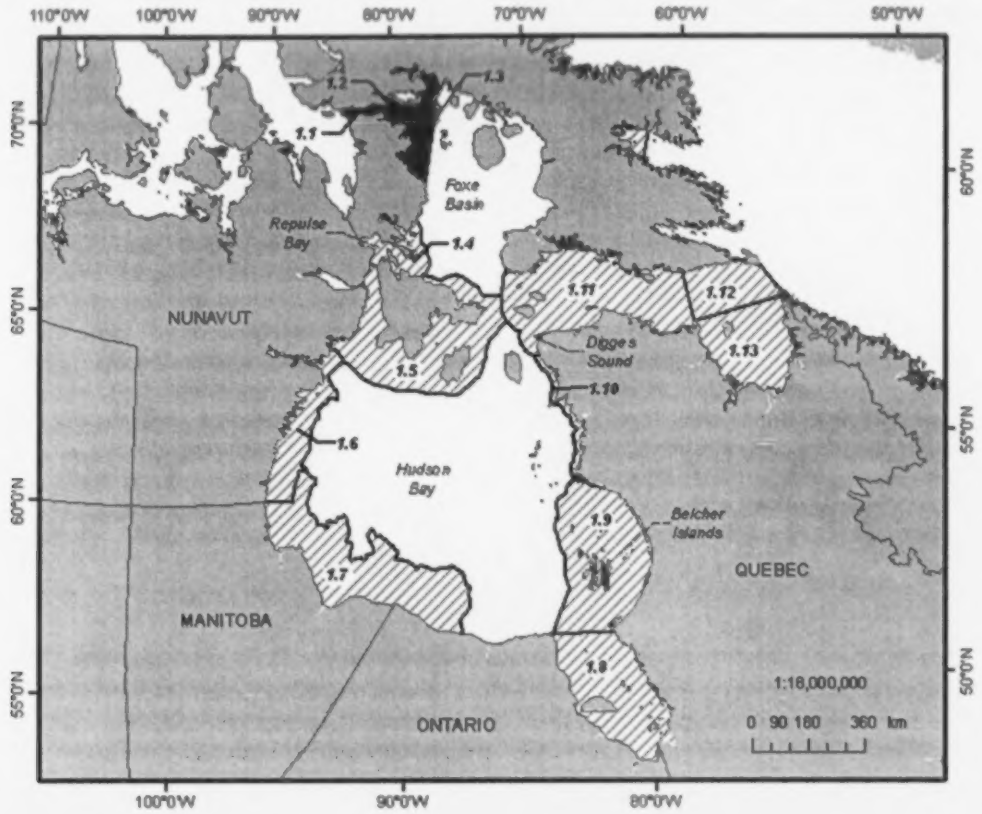

Figure 3. Preliminary EBSA identification results for the Hudson Bay Complex biogeographic region. EBSAs identified through a series of workshops conducted in 2009 (DFO 2010a) are identified in red (1.1-1.3) within Foxe Basin and the preliminary EBSA identification results for the Hudson and James bay and Hudson Strait sub-regions (red hatched lines).

Foxe Basin

The DFO (2004) EBSA criteria were applied in northern Foxe Basin in 2009 (DFO 2010a) in order to identify potential areas for consideration as a MPA. In order to consider all relevant information, two meetings were planned. The first was held in Winnipeg and included participants from DFO Central and Arctic Region Science, Oceans Programs Division and Fisheries and Aquaculture Management (FAM) staff as well as specialists from the Government of Nunavut, PCA, Natural Resources Canada (NRCan) and the Canadian Wildlife Service (CWS) of Environment Canada. A second meeting was held in the community of Igloolik which gave local residents the opportunity to review the information compiled. Participants at these meetings included DFO Oceans Programs Division staff, the Igloolik Hunter and Trapper Association, and local elders and community members. An additional meeting was held to gain input from Hall Beach community members who also traditionally use the area under discussion. The results of all three meetings were complied and evaluated against the EBSA criteria, and a total of three EBSAs were identified (DFO 2010a).

Hudson and James bays

Six important areas were identified in the Hudson Bay/James Bay region (Figure 3, Table 1). These areas were selected based on differences in physical oceanography, bathymetry, seasonal use by marine mammals and marine birds, and productivity. Hudson Bay was the subject of a comprehensive ecosystem overview and assessment report in 2005 (Stewart and Lockhart 2005), therefore data confidence for most layers is quite high.

1.4 Repulse Bay/Frozen Strait

With a complex oceanography resulting from bathymetry and strong currents (including two recurrent polynyas), the Repulse Bay and Frozen Strait area is considered an important area for a number of marine mammals, seabirds and Arctic Char (*Salvelinus alpinus*). The only summer aggregation for Northern Hudson Bay Narwhal occurs in Repulse Bay, Frozen Strait, western Foxe Channel and Lyon Inlet. These Narwhal are considered to be a distinct population and are listed as *Special Concern* under COSEWIC (2004b). Eastern Arctic Bowhead aggregate in summer in two areas of the Repulse Bay/Frozen Strait region. Northern Hudson Bay-Davis Strait population of Atlantic Walrus (*Special Concern* under COSEWIC 2006) use the area year-round. There is a possibility that some Walrus from northern Foxe Basin may be migrating south to this area as well (J. Hamilton, DFO, Winnipeg, MB, pers. comm.). Numerous tagging studies have documented with a high degree of certainty the presence and seasonal migration of Narwhal in this region, aerial surveys and IQ have documented habitat importance to Bowhead. A significant proportion of the Canadian population of Iceland Gulls (*Larus glaucoides*) occurs in Frozen Strait.

1.5 Southampton Island (including Coats Island)

Southampton Island is the largest island in Hudson Bay, and is situated near the confluence of Hudson Bay and Foxe Basin waters. This results in dynamic oceanographic mixing, and fairly high marine productivity in the area. Summer and winter use by the Northern Hudson Bay-Davis Strait population of Atlantic Walrus (COSEWIC 2006) occurs on Southampton and Coats Island. The waters surrounding Southampton Island are important spring and fall migration routes for Beluga and Eastern Arctic Bowhead (*Special Concern* under COSEWIC 2009). Important nesting areas occur on Coats Island for seabirds (Thick-billed Murre (*Uria lomvia)*, Common Eider (*Somateria mollissima*) and Black Guillemot (*Cepphus grille)*) which feed on aggregations of marine fish (e.g., Capelin and Arctic Cod) (Mallory and Fontaine 2004). The largest single colony of Common Eider in Nunavut occurs in East Bay. Southampton, Coats and Mansel Islands are also considered important for Polar Bear denning and as important summer refuge habitat for the Foxe Basin Polar Bear population. The bears also frequent the land-fast ice adjacent to the islands in winter. Data confidence for this area is high due to intensive marine bird studies, tagging and survey data for marine mammals and published IQ. The Southampton Island area scores high for several EBSA criteria (Table 1).

1.6 Western Hudson Bay (Whale Cove to Arviat)

This area is important for Beluga and Killer Whales, seabirds and Arctic Char. Dense kelp beds occur along the coastline and provide important habitat for fish in the area. This area has a wealth of LEK and TEK from the communities of Whale Cove, Rankin Inlet and Arviat on the importance of marine mammals and fish (DFO 2011). Important Arctic Char stocks exist in this area and use the marine environment for feeding.

1.7 Western Hudson Bay/Churchill/Nelson/Seal Estuaries

The Nelson and Churchill estuaries provide an important habitat for a number of marine mammals and fish. The world's largest summer aggregation of Beluga (*Special Concern* under COSEWIC 2004a) occurs in the Nelson River estuary, with smaller numbers in the Churchill River estuary. Although the reason for these aggregations is not known, two commonly reported hypotheses are: 1) thermal advantage from warm freshwater to initiate moulting, and; 2) an evolutionary adaptation to take refuge from predation by Killer Whales in the shallow estuaries. Regardless of the reason, Beluga aggregations of about 70,000 western Hudson Bay Beluga (*Special Concern* under COSEWIC 2004a) are significant for population fitness consequences. The Churchill area is also a key denning, feeding and jump off point for Western Hudson Bay Polar Bear which head north along the newly formed ice to hunt Ringed Seal (*Phoca hispida*). This population of Polar Bear is listed as Threatened under *The Endangered Species Act* of Manitoba (February 2008). A relatively high degree of certainty exists for bio-physical data because of environmental impact assessments by Manitoba Hydro projects on the Nelson and Churchill rivers, as well as ongoing climate change studies on Polar Bear, seals, Killer Whale and Beluga.

The Seal River estuary was identified in 1999 as an Important Bird Area and is globally significant for migrating Black Scoter (*Melanitta nigra*). The Seal River is a Canadian Heritage River and remains a pristine, high quality, remote wilderness river. It is the largest remaining undammed river in northern Manitoba. Harbour Seals travel up the Seal River estuary and throughout its entire course, 160 km or more inland. This is a significant and little-understood adaptation to the freshwater environment by a marine mammal, and is possibly the most pronounced occurrence worldwide. The estuary supports a population of up to 3,000 Beluga that come annually to rear young and feed in its waters, and supports summer and fall concentrations of Polar Bear.

The Province of Manitoba has designated a number of legally protected and managed lands, and identified Areas of Special Interest (candidate protected areas) along the Manitoba coastline for various ecological and biological reasons (Figure 4). Five internationally recognized Important Bird Areas have also been identified along this part of Hudson Bay. Wapusk National Park and the provincially designated Churchill Wildlife Management Area, which extend to Manitoba's border (ordinary low water mark) and protect one of the world's largest known Polar Bear maternity denning areas. The national park also protects important Caribou (*Rangifer tarandus*) habitat. Similarly, the Kaskatamagan Wildlife Management Area (provincial designation) was established to protect the fragile coastal and tundra ecosystems and to protect important habitat for a number of bird species. Polar Bear maternity denning areas are located in the protected part of the wildlife management area, and Caribou and Polar Bear wade into the waters off the coast of Kaskatamaganto to cool off from the summer heat and to avoid insect pests. The Churchill Special Conservation Area, designated to conserve and protect the Ross's Gull (*Rhodostethia rosea*), is also an integral part of the primary Polar Bear migration corridor in Manitoba. Hubbart Point, located north of the Seal River estuary, is an aggregation area for older male Polar Bear during the ice-free season and as such, females and cubs tend to stay away from this area. Beluga also congregate in the waters off of Hubbart Point, which is part of the North Hubbart Area of Special Interest.

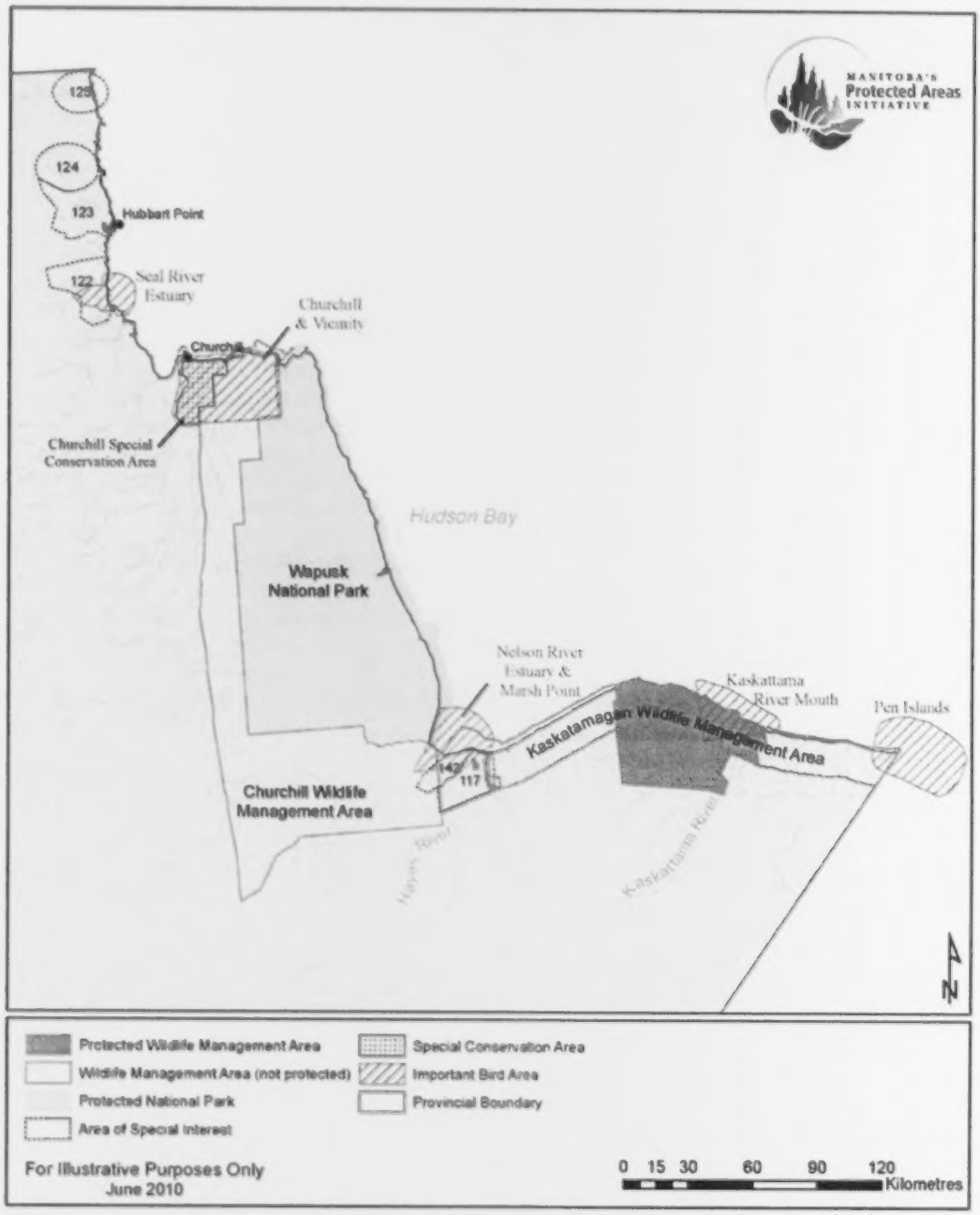

Figure 4. Province of Manitoba legally designated lands, Areas of Special Interest (candidate protected areas) and Important Bird Areas which occur along Manitoba's coastline and Hudson Bay (courtesy of Jenny Harms, Province of Manitoba, Winnipeg, MB). www.manitobaprotectedareas.com.

1.8 James Bay

Although closely coupled oceanographically to the Hudson Bay marine region, James Bay is typically shallower and therefore more homogenous and dilute due to the large amount of freshwater runoff into a relatively confined area (Ingram and Prinsenberg 1998). James Bay also supports a variety of warm-water species that are relicts of an earlier connection with the Atlantic and Pacific oceans. These plants and animals have disjunct distributions and are rare or absent elsewhere in Canada's Eastern Arctic waters. James Bay is essentially a very large estuary with a number of rivers emptying into it. Approximately 8,000-16,000 Beluga aggregate in summer and there are indications based on IQ that some of these whales remain there year-round. This may be a distinct stock, separate from the Western Hudson Bay Beluga, although some uncertainty exists because the distribution range of the Western Hudson Bay Beluga does exist along the southern coast of Hudson Bay. Atlantic Walrus from the South and East Hudson Bay population (*Special Concern* under COSEWIC 2006) occupy Cape Henrietta Maria on the northwest coast of James Bay. James Bay is also an important area for Polar Bear denning. Polar Bear use Akimiski Island during the summer which is perhaps the most regular southerly location in the world that is used regularly by Polar Bear. These bears frequent James Bay and the southeastern Hudson Bay arc, extending as far north as the Belcher Islands during winter where prime Ringed Seal habitat exists.

Some of the northern-most sub-tidal eelgrass beds occur along the east coast of James Bay and along the coasts of Akimiski Island, and these provide habitat used by waterfowl and juvenile sculpins. Anadromous fish species are also abundant in the lower salinity water of James Bay. Black Scoter use the west side of James Bay (97% of the Canadian moulting population), where they feed on blue mussels and other molluscs (Mallory and Fontaine 2004). This habitat is also of importance to national and global populations of staging shorebirds. Bio-physical knowledge of this area is quite extensive due to environmental impact assessments from the large hydro dams in Quebec and Ontario. There is still uncertainty as to the relationship of Beluga and Walrus with other Hudson Bay stocks. This area scores high for several of the CBD EBSA dimensions (Table 1).

1.9 Eastern Hudson Bay/Belcher Islands

Atlantic Walrus are found in the Sleeper/Belcher archipelago in both summer and winter (COSEWIC 2006). In summer Eastern Hudson Bay Beluga (*Endangered* under COSEWIC 2004a) aggregate around the Nastapoka and Little Whale rivers, with their main summer coastal occupancy ranging between Kujjuarapik to Inukjuak. These whales migrate to the area from Hudson Strait during spring, following a route that is quite far offshore. Tagging data show that Beluga migrate north to Hudson Strait to over-winter; however IQ has documented whales within the Belcher/Eastern Hudson Bay area during winter. Ringed Seal and Polar Bear are common in this region. Diversity of habitats and species is high in the surrounding waters, including invertebrates such as Sea Urchins, Sea Cucumbers and bivalves that form traditional Belcher Island Inuit diets. The area supports most of the world's population of Hudson Bay subspecies of Common Eider throughout the year (Gilchrist and Robertson 2000, Mallory and Fontaine 2004). Data confidence is relatively high, as several key marine mammal stocks have been assessed in this area. A wealth of IQ exists as a result of the "Voices from the Bay" study (McDonald et al. 1997).

Hudson Strait

1.10 West and Central Hudson Strait

The West and Central Hudson Strait region is a unique body of water. It is a conduit for Arctic waters via Foxe Basin, the outflow of Hudson Bay water, and also periodic intrusions of Atlantic water into northeastern Hudson Bay. It is a major seasonal migration route (choke point) for all marine mammals that spend the summer in Hudson Bay and Foxe Basin (and beyond), and winter in either Hudson Strait, and/or Davis Bay, including Beluga, Narwhal, and Bowhead. Walrus spend winters in west and central Hudson Strait on ice flows and on islands such as Nottingham and Salisbury, where strong currents maintain open water. Walrus also overwinter on the northern shore of Hudson Strait near Kimmirut. Productivity is higher in West and Central Hudson Strait than Foxe Basin or Hudson Bay. There are a number of important seabird nesting and feeding areas which occur on the northern and southern shores. Twenty percent of the North American population of Thick-billed Murres and a small colony of Atlantic Puffins (*Fratercula arctica)* are found near the Digges Sound and 10% of the Canadian population of Common Eiders breed and feed near Markham Bay (Mallory and Fontaine 2004). The physical oceanography has been well studied as part of long-term studies on Arctic flow-through. The use of Hudson Strait by migrating marine mammals has been well documented through tagging studies and IQ.

1.11 Eastern Hudson Strait

In addition to the same factors that contribute to the ecological significance of West and Central Hudson Strait, the eastern Hudson Strait is heavily influenced by oceanographic conditions from Davis Strait and is an important area for shrimp. A portion of the Canadian Shrimp Fishing Area 3 occurs near Northern Ungava Bay eastward to Resolution Island. The western extent of Greenland Halibut (*Reinhardtius hippoglossoides)* habitat occurs in Eastern Hudson Strait. Eastern Hudson Strait is a significant overwintering refugium for Hudson Bay Beluga and approximately 5000-8000 Bowhead winter in this area. There are also relatively significant occurrences of cold water corals in the deeper waters of the strait (Kenchington et al. 2011).

1.12 Ungava Bay

Ungava Bay is a large bay adjacent to Nunavik, northern Quebec. The bay is rimmed with many small islands. The main current flow is east through Hudson Strait and the tides in this area are very high, similar to the Bay of Fundy (C. Hannah, DFO, Halifax, NS, pers. comm.). Ungava Bay Beluga, which at one time had summer aggregations at the mouth of the Mucalic, George and Whale Rivers, have been reduced to as few as approximately 50 and may be extirpated (*Endangered* under COSEWIC 2004a). There are also relatively significant occurrences of corals in the deeper waters of the bay (Kenchington et al. 2011).

Two large colonies of Thick-billed Murre occur on Akpatok Island (Mallory and Fontaine 2004). Collectively, these colonies constitute the largest number of breeding Thick-billed Murre in Canada (>20% of the Canadian population). Black Guillemot also nest along the Akpatok Island coast. A large portion of the breeding population of Common Eider aggregate on the islands of the western shore of Ungava Bay. Key nesting sites occur at the Eider, Plover, Payne and Gyrfalcon islands and the islands of northeastern Ungava Bay. Approximately 80-100 Polar Bear (about 5% of the Davis Strait population) are denning and rearing along the southern shore of Akpatok Island in summer.

2.0 EASTERN ARCTIC

The Eastern Arctic contains some of the most productive, diverse and important Canadian Arctic marine ecosystems. Oceanographically, the Eastern Arctic is a major pathway connecting the Pacific and Atlantic oceans. The freshwater and heat exchange into Baffin Bay follow one of three main pathways: 1) Lancaster Sound/Barrow Strait, 2) Jones Sound or, 3) Nares Strait. During the summer, the highest flow occurs through Nares Strait (46%; Kleim and Greenberg 2003). The surface waters are biochemically altered by mixing and thermodynamic processes. Currents are strongly tidal (e.g., peak flow 50 cm/s in Barrow Strait). High current rates (10-30 cm/s) cause turbulent mixing at the ice-water interface such that surface waters are resupplied with nutrients, supporting abundant sea-ice biomass and production. Most marine fish and mammals are associated to varying degrees of sea-ice or ice-edges during migration and summer/winter aggregations. The Arctic Cod is a key species in the marine food web in the High Arctic. No other species compares with its abundance and energetic value. This species acts as a conduit for a major part of the energy flow between phytoplankton, zooplankton and vertebrates.

Recurrent polynyas form important habitat due to upwelling of nutrient rich waters, which precondition the area for enhanced primary and secondary productivity during summer (Barber et al. 2010). Although the diversity of marine fish species is relatively high in the sub-regions within the Eastern Arctic biogeographical region, more data is available for Baffin Bay and Davis Strait as a result of multi-species groundfish surveys conducted by DFO.

For the purpose of discussing and mapping areas of importance in the Eastern Arctic, two areas and their adjoining water-ways will be examined: 1) Lancaster Sound/Barrow Strait and, 2) Davis Strait/Baffin Bay (Figure 5). A total of 18 EBSAs were identified in this biogeographic region (Figure 6).

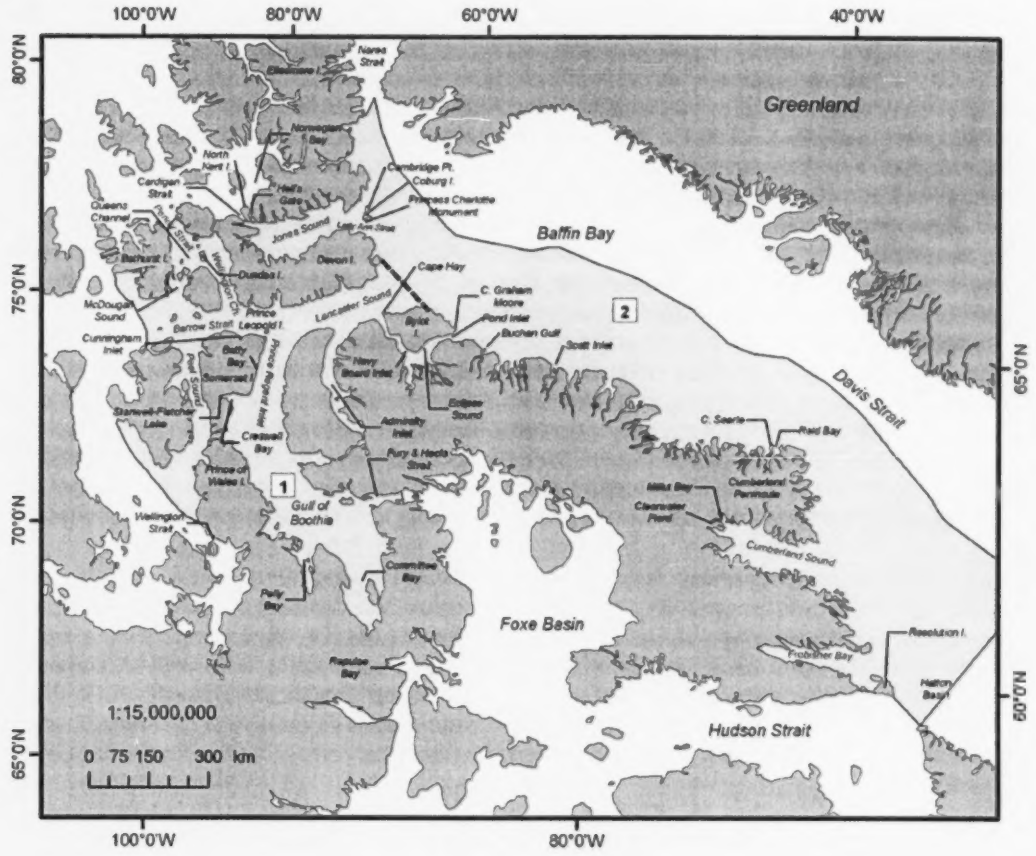

Figure 5. Eastern Arctic biogeographic region (tan shading) divided into two sub-regions for EBSA evaluation: 1) Lancaster Sound/Barrow Strait and 2) Davis Strait/Baffin Bay.

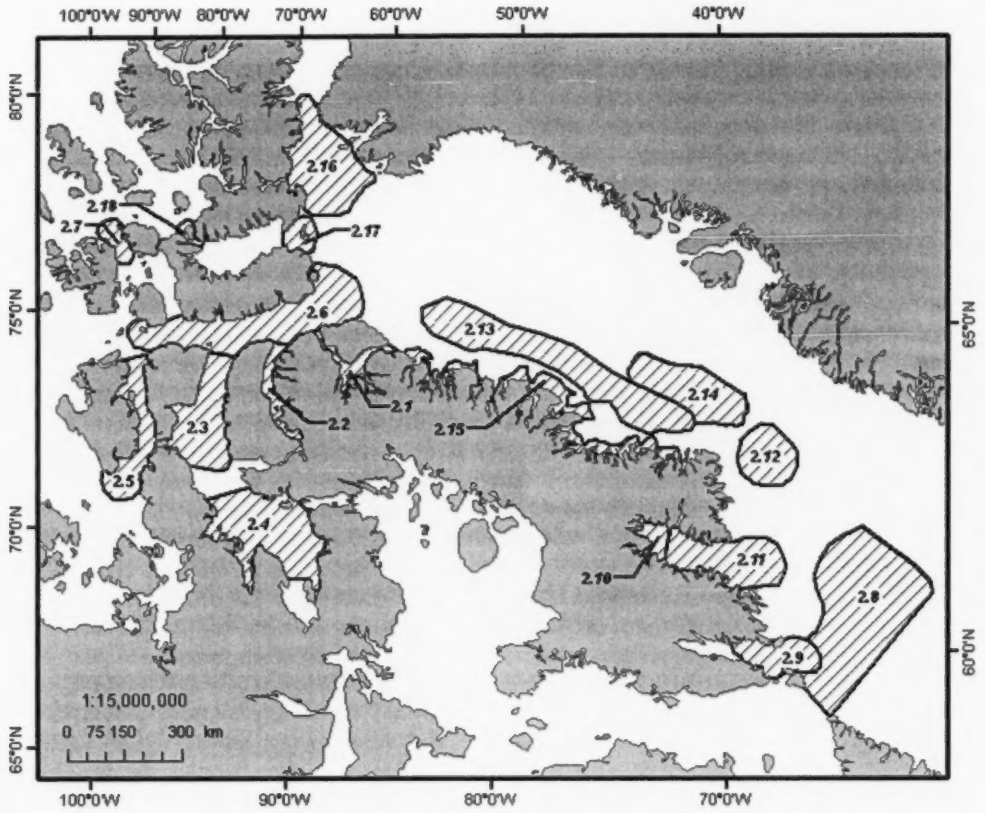

Figure 6. Preliminary EBSA identification results for the Eastern Arctic biogeographic region.

Lancaster Sound/Barrow Strait Complex

The area of Lancaster Sound/Barrow Strait Complex includes waters from the east side of Bylot Island westward to the western extent of Barrow Strait (a line between Prince of Wales and Bathurst Island) including all adjoining waterways therein (Figure 5). It also includes adjoining waters such as Peel Sound, Prince Regent Inlet, Gulf of Boothia, Admiralty Inlet, Navy Board Inlet, Penny Strait, Wellington Strait, Queens Channel, and other small waterways of the Queens Channel islands. The Lancaster Sound/Barrow Strait Complex constitutes about 98,000 km^2 of sea surface (Welch et al. 1992). Ocean currents are dominated by southward and eastward flow out of the Polar Basin into Baffin Bay via Barrow Strait, McDougall Sound, Wellington Channel, and Lancaster Sound. A complex set of eddies and counter currents form when waters of Lancaster Sound mix with water from north-south channels. The western end of Barrow Strait is a relatively shallow sill of 150 m depth, with deeper water in the surrounding channels and particularly eastward toward Baffin Bay. The sill constricts the eastward flow, resulting in turbulence and complex water movements in the downstream portion of Barrow Strait, where water masses enter from Wellington Channel and Peel Sound (Prinsenberg and Bennett 1987).

The Lancaster Sound region is considered the "jewel" of the north, containing internationally recognized natural habitat features that are critical to seabirds and marine mammals (Kirk 2011). It is home to at least six species listed by COSEWIC and/or SARA in Canada. These

include the *Endangered* Ivory Gull (*Pagophila eburnea*), as well as species of *Special Concern* as assessed by COSEWIC - Bowhead, Polar Bear, Narwhal, Atlantic Walrus, the Eastern Arctic/Baffin Bay population of Beluga, and the Northwest Atlantic/Eastern Arctic population of Killer Whale. Other mammals, such as the Bearded Seal (*Erignathus barbatus)*, are listed as data deficient. Lancaster Sound supports significant proportions of the Canadian populations of these species during one or more seasons of the year, for example 25% of Canada's Polar Bear population, 80% of Bowhead, and most of the Eastern Arctic/Baffin Bay Beluga and Baffin Bay Narwhal populations pass through Lancaster Sound during their annual migration to and from their summering habitat. Lancaster Sound is currently under consideration by Parks Canada for the establishment of a National Marine Conservation Area.

Because of the high number of highly migratory animals using this region, and the importance of open water and ice-edge habitat to which most marine mammals are attuned, it becomes challenging to identify specific areas of importance since these features change seasonally and annually depending upon ice dynamics. However, polynyas based on bathymetry and water movement, for the most part recur annually (Smith and Rigby 1981, Hannah et al. 2009). During the 1970's hydrocarbon exploration and development in the Lancaster Sound area led to the identification of important marine areas; more recent multi-year surveys and/or marine mammal tagging studies in combination with IQ has added to this knowledge.

2.1 Eclipse Sound/Navy Board/Pond Inlet

The marine portion of Eclipse Sound/Navy Board/Pond Inlet covers about 13,400 km^2 with maximum depths of 200 m. The relatively deep waters surrounding Bylot Island, and the connection to Lancaster Sound are very important migration routes and summer feeding aggregation areas for approximately 20,000 Baffin Bay Narwhal. Narwhal show high site fidelity; spring migrants arrive in Pond Inlet then move into Eclipse Sound and Navy Board Inlet. Eclipse Sound/Navy Board Inlet/Pond Inlet is used by Ringed Seal, Harp Seal (*Phoca groenlandica*), Killer Whale, Beluga and Polar Bear. Cape Hay on the northwest end of Bylot Island supports colonies of Thick-billed Murre, and Black-legged Kittiwake (*Risa tridactyla*), which forage 30-60 km out to sea (Mallory and Fontaine 2004). Northern Fulmar (*Fulmarus glacialis*) use this area as a staging area. Cape Graham Moore on the southeast point of Bylot Island is home to Thick-billed Murre and Black-legged Kittiwake.

2.2 Admiralty Inlet

The marine portion of Admiralty Inlet encompasses approximately 8557 km^2, with maximum depths of 400 m. The combination of water flowing out of Admiralty Inlet which then mixes with waters from Lancaster Sound and the presence of strong tides produces local nutrient enrichment in Admiralty Inlet. This productivity is reflected in the high use by seabirds, along with marine mammals such as Bowhead, Narwhal, Beluga and Ringed and Harp seals. The presence of these mammals, which feed primarily on marine fish, is suggestive of a substantial marine fish population. Approximately 10,000-15,000 Narwhal spend the summer in Admiralty Inlet and migrate to southern Baffin Bay for winter (Dietz et al. 2008, Laidre et al. 2010). Baillarge Bay on Admiralty Inlet is occupied by Northern Fulmar and Glaucous Gull (*Larus hyperboreus*). IQ documents extensive seabird feeding in the marine waters of Admiralty Inlet (Mallory and Fontaine 2004). Data confidence is high for marine mammals and seabirds based on surveys and tagging studies.

2.3 Prince Regent Inlet/Somerset Island

Prince Regent Inlet encompasses 19,103 km^2, with depths of 400 m. Strong water currents flow west from Barrow Strait along the southern coast of Devon Island, with a substantial water transfer south into Prince Regent Inlet. In addition, a recurrent polynya forms at Bellot Strait due to tidal currents in the area.

Prince Regent Inlet is an important area for the Eastern High Arctic/Baffin Bay Beluga (*Special Concern* under COSEWIC 2004b), which use shallow estuaries like Creswell Bay, Batty Bay, and Cunningham Inlet in July and August. The warm brackish waters in estuaries are thought to enhance skin moult and also provide protection for Beluga from Killer Whale (Richard and Stewart 2008). About 20,000 Narwhal summer in the deeper bays and fjords of Prince Regent Inlet and have been shown to have high annual site fidelity and seasonally narrow feeding ranges, based on tagging studies. Tagged Narwhal from Somerset Island migrate to mid-Baffin Bay for winter (Heide-Jørgensen et al. 2003), so they are considered distinct from the stocks that were tagged near Admiralty Inlet. Arctic Char from Stanwell Fletcher Lake migrate out to nearshore marine waters to feed. Batty Bay and Creswell Bay are important marine areas for Black-legged Kittiwake, Northern Fulmar, King Eider (*Somateria spectablilis*) and Common Eider (Mallory and Fontaine 2004).

2.4 Gulf of Boothia/Pelly Bay/Committee Bay

The Gulf of Boothia, Pelly Bay and Committee Bay is an important nursery area for Eastern Arctic Bowhead that migrate south from Lancaster Sound and west from Foxe Basin through Hecla and Fury Strait (Heide-Jørgensen et al. 2010). From about late July to October females nurse their calves in the Gulf of Boothia-Prince Regent Inlet region (DFO 2009b). During this time, they feed on pelagic and epibenthic zooplankton. Ferguson et al. (2010) stated that although intensive feeding has also been recorded in late winter-early spring (Lee et al. 2005, Laidre et al. 2007), these summer feeding areas are likely critical to their annual cycle of fat deposition and catabolism. Large numbers of Narwhal and Beluga are present during the summer in the Gulf of Boothia. Like the Bowhead, some Beluga may migrate into the Gulf of Boothia via Hecla and Fury Strait. There is also a recurrent polynya present in Committee Bay (Hannah et al. 2009).

2.5 Peel Sound/Barrow Strait

Peel Sound and Barrow Strait covers about 26,938 km^2. Maximum depths range from about 200-400 m. A sill is located in Barrow Strait (about 150 m depth) that restricts the eastward flow of water. Prince Regent Inlet is linked to Peel Sound through Bellot Strait. The population of Narwhal that inhabit water around Somerset Island use both the Prince Regent Inlet EBSA and the Peel Sound and Barrow Strait EBSA for feeding throughout the summer. Eastern Arctic Beluga also aggregate in Barrow Strait and Peel Sound during summer. The fact that both species aggregate in such large numbers would indicate that the area is highly productive and supports large marine fish populations.

2.6 Lancaster Sound

Lancaster Sound proper covers an area of about 26,335 km^2 and maximum depths range between 200 and 800 m (Welch et al. 1992). Lancaster Sound is a major migratory route (choke point) for Bowhead moving to and from their summer range in waters adjoining Lancaster Sound. Other migratory species using Lancaster Sound include Beluga, Narwhal, Killer Whale and seals. Eastern Lancaster Sound has a recurrent polynya that supports a variety of marine

fish, Atlantic Walrus, Beluga, Polar Bear, several species of seals and seabirds. Approximately 100,000 Harp Seal use the eastern Lancaster Sound region in the summer. Arctic Cod is abundant in all phases of its life cycle in Lancaster Sound and is a key species in Arctic food webs transferring energy from lower to higher trophic levels. Arctic Cod are important prey for seabirds such as Northern Fulmar and Black-legged Kittiwake and marine mammals and can affect the distributions of these animals during the summer months. The waters around Prince Leopold Island are critical for a variety of Arctic seabirds, including Thick-billed Murre, Black-legged Kittiwake, Northern Fulmar, and Black Guillemot. The abundance of seabirds can be used as a proxy to identify exceptionally high productivity in the surrounding marine area. The major current interactions around Prince Leopold Island (65–100 cm/s) create local enrichment of nutrients and enhance phytoplankton growth with consequent effects up the food chain, resulting in highly suitable conditions for a variety of marine fauna. Lancaster Sound has also been found to have among the highest benthic biomass in the Arctic (Thompson 1982).

2.7 Penny Strait/Wellington Channel/Queen Channel Islands

Strong currents maintain a polynya in Penny Strait/Dundas Island area, and it is an important area for Atlantic Walrus and Ross' Gull. Walrus winter every year in the Penny Strait–Queens Channel areas, at the Dundas Island polynya and use the area to haul-out year-round. The Cheyne Islands support the largest known nesting population of Ross's Gull (SARA) in the Canadian Arctic (Mallory and Fontaine 2004).

Davis Strait/Baffin Bay

The Davis Strait/Baffin Bay area covers the entire offshore Canadian waters along the length of Ellesmere, Devon and Baffin Island, encompassing an area of approximately 1.1 million km^2. The narrow and relatively shallow area between Baffin Bay and the Labrador Sea is known as Davis Strait. Davis Strait is a large stretch of water over 950 km across at its greatest width and never less than 300 km wide. At the narrowest point, the submarine topography consists of an under-sea ridge, a continuation of the mid-Labrador ridge, extending from the coast of Baffin Island to Greenland. The shallowest waters in the strait are found along this sill, from 350 to 550 m deep, before plunging down to abyssal basins on either side. Some of the greatest depths in the eastern Arctic (3660 m) occur off the shelf along the southern end of the strait. To the north, Baffin Bay is connected to the Arctic Basin only by the narrow, shallow (<200 m) Nares Strait. The surface water temperature is about 0 °C, and beneath this there is a cold-water layer (<0 °C) often more than 100 m thick. At about 64°N, a branch of the West Greenland Current sets westward bringing relatively warm Atlantic water to the Canadian side of Davis Strait. North of the ridge, the remainder of the West Greenland Current flows into the eastern part of Baffin Bay as a weak current setting northward. The east coast of Baffin Island is dominated by the cold Polar Current, which originates in the Arctic Basin and sets southward along the coast. This current moves across the shallow shelf off southeast Baffin Island where it meets the branch of the West Greenland Current described above to form the Labrador Current and sets south along the Labrador coast.

In the Canadian Arctic, the Davis Strait/Baffin Bay region supports a wide diversity of marine fish (Jørgensen et al. 2005), both summer and winter populations of marine mammals, and aggregations of deep-water corals and sponges (Kenchington et al. 2011). A number of distinct areas are assessed as potential EBSAs.

2.8 Southern Davis Strait

The Southern Davis Strait area is bound by Hudson Strait to the west, the Saglek Bank to the south, and Davis Strait to the north, including Hatton Basin. This area is the only known overwintering area for Northern Hudson Bay Narwhal. Members of this stock summer near Repulse Bay, then migrate through Hudson Strait to South Davis Strait to spend the winter feeding on the rich abundance of marine fish and invertebrates. This overwintering area is distinct from other Canadian Arctic Narwhal stocks. It is an area of high productivity and diversity of marine fishes. This area supports a productive *Pandalus* shrimp population within Canadian Shrimp Fishing Area 2. An important coral diversity and abundance hotspot occurs in the Hatton Basin, extending more or less continuously from the northern edge of Saglek Bank northward to the southeast shelf of Baffin Island (Wareham and Edinger 2007, Edinger et al. 2007). This area has the highest recorded biomass of corals in survey trawls throughout the region, and is the only area with abundant *Primnoa resedaeformis* and *Paragorgia arborea* north of the Stone Fence off Nova Scotia (Gilkinson and Edinger 2009). A Hooded Seal (*Cystophora cristata*) whelping area has also been identified to exist within this EBSA (Stephenson and Hartwig 2010).

2.9 Frobisher Bay

The outer Frobisher Bay area is characterized by a recurrent polynya, which can extend down as far as Resolution Island. Outer Frobisher Bay forms an important Atlantic Walrus and Eastern Bowhead overwintering area. Beluga utilize Frobisher Bay in the summer, and may overwinter at the outer edge of the polynya. Killer Whale also frequent Frobisher Bay. TEK suggests that the mouth of Frobisher Bay is an important feeding, staging, and breeding area for over 15 species of marine birds (Riewe 1992). These include Thick-billed Murre, Black-legged Kittiwake, Black Guillemot and Iceland Gull (Mallory and Fontaine 2004).

2.10 Cumberland Sound (inner)

Cumberland Sound is a large bay, with maximum depths ranging in excess of 1000 m. The deepest parts (500-1000+ m) are in a trench in the mid-eastern portion of the Sound which is separated from Davis Strait by a sill near its mouth. Fjords on the northeast and eastern side are also deep (100+ m). Clearwater Fjord ranges down to 190 m and in its mid-northern portion, the bottom rises steeply to form a shallow bay called Millut Bay which is the only summer aggregation area for the Cumberland Sound Beluga population (Richard and Stewart 2008), which is listed as *Threatened* under COSEWIC (2004a). Several kilometres from the western shores of Cumberland Sound, there are two deeper basins which provide key habitat for the inshore Greenland Halibut stock. This may be a distinct stock which does not interact with the offshore Greenland Halibut stocks of Davis Strait and Baffin Bay (M. Treble, DFO, Winnipeg, MB, pers. comm.). Several thousand Common Eider concentrate along the coasts and fjords of Cumberland Sound during August and September. The islands of western Cumberland Sound appear to support the largest breeding concentration of Iceland Gull in Canada (Mallory and Fontaine 2004).

2.11 Cumberland Sound (outer)

The outer Cumberland Sound area provides the only winter habitat for the Cumberland Sound Beluga stock (*Threatened* under COSEWIC 2004a). A large recurrent polynya occurs near the southeast coast along Cumberland Peninsula, likely caused by a combination of winds and currents. This is where the Beluga are observed in January and February. Eastern Arctic Bowhead and Atlantic Walrus also utilize the Cumberland Sound polynya during winter (Richard and Stewart 2008). Thick-billed Murre, Black-legged Kittiwake, Black Guillemot, Dovekie (*Alle*

alle) and Iceland Gull either directly use Cumberland Sound as nesting areas, or use the Sound during spring staging or fall migrations to and from Cape Searle and Reid Bay, which are located several hundred kilometres north (Mallory and Fontaine 2004).

2.12 Northern Davis Strait

The surface waters in this area are strongly affected by counter-clockwise flowing currents. Along the west side there is an outflow of cold water from the Arctic Basin which moves south at flow velocities of 8-20 km/day feeding the Labrador Current. On the east side the west Greenland counter-current brings warmer water north. Ice conditions reflect this flow regime, with heavy ice movement and icebergs along the western shore, contrasting sharply with more open water along the Greenland side. Northern Davis Strait is an overwintering area for Bowhead and some of the High Arctic Narwhal stock from Admiralty Inlet. The area supports a large marine fish community (Jørgensen et al. 2005) and contains some relatively significant occurrences of coral.

2.13 Baffin Bay Shelf Break

Along eastern Baffin Island, a distinct steep faced shelf break plunges from between 500 and 1500 m. Marine fish occur along the shelf break (Jørgensen et al. 2005). LEK/TEK identify this area as important migration routes for Bowhead and seals (Harp, Hooded, Ringed and Bearded; DFO 2011).

2.14 South Baffin Bay

Southern Baffin Bay is at an oceanographic area that marks a break between warmer southern Labrador Current and the cold Arctic outflow. It is an overwintering area for several stocks of Narwhal (the "southern" Baffin Bay Narwhal overwintering area; Dietz et al. 2001, Heide-Jørgensen et al. 2002, Laidre et al. 2003). Several species of cold water coral occur in significant numbers in this area. As a result a Greenland Halibut fishing closure was created in this area (DFO 2007). Productive Greenland Halibut fishing grounds are also found in southern Baffin Bay. This area is identified as a Bowhead winter refugium.

2.15 Baffin Island coastline

The Baffin Island coastline is a complex coastline of deep fjords intersecting the relatively shallow east Baffin Island shelf. The area provides feeding aggregation areas for Bowhead and Narwhal during the summer and also during their migration to and from the High Arctic. Isabella Bay is a National Wildlife Conservation Area based on its importance to Bowhead feeding and nursery area. Ringed Seal use the fjords and coastal areas out to about 15 km. Atlantic Walrus also have important haul-out areas along this complex coastline. Several key seabird colonies are located along this coast, and birds often go to great distances offshore to feed on marine fish. Cape Searle, (locally known as Qaqulluit) is reported to be Canada's largest colony of Northern Fulmar (Mallory and Fontaine 2004). Glaucous Gull, Iceland Gull, and Black Guillemot are also numerous here. Reid Bay (locally known as Akpait) is one of Canada's largest Thick-billed Murre colonies, Northern Fulmar, Black-legged Kittiwake, Glaucous Gull and Black Guillemot also nest at this location. TEK also suggests that Atlantic Puffin occur here (M. Mallory, unpublished data). Other important East Baffin Island marine areas for seabirds include Buchan Gulf and Scott Inlet. The coastal areas and fjords provide important feeding and rearing areas for Polar Bear from the Baffin Bay Polar Bear population. In addition to the above mentioned species, LEK/TEK report observations of dolphins, Killer Whales, Minke Whales and Bowhead migration throughout the fjords (DFO 2011).

2.16 North Water

The North Water Polynya is a large, year-round expanse of open water in northern Baffin Bay, between Ellesmere Island and Greenland. It is the largest and most productive polynya in the Canadian Arctic and Greenlandic waters. In addition to the tremendous marine bird resources in this area, the North Water is of significance to more species of marine mammals than any other polynya in the Canadian Arctic (Stirling et al. 1981). It is used by Beluga in the summer and winter, Bowhead and Narwhal in summer, migratory Walrus, Ringed Seal (Holst et al. 2001), Bearded Seal and Harp Seal during all seasons. A large population of Polar Bear also relies on the productivity of Ringed Seal in the fast ice adjacent to the North Water Polynya over the winter and spring (Stirling et al. 1981). Millions of seabirds breed in the vicinity of the North Water Polynya. Most feed in the North Water and some overwinter there. Approximately 30,000 pairs of Black-legged Kittiwake, representing 16% of the Canadian population, nest at Cambridge Point, Coburg Island (Mallory and Fontaine 2004). Over 350,000 pairs of Thick-billed Murre nest in six colonies around the margin of the North Water Polynya. Fourteen colonies of Ivory Gull (listed under SARA) are located on southeastern Ellesmere Island, supporting 730–830 adults. Some Black Guillemot (175 pairs) breed at Coburg Island, and 3000–4000 overwinter in this area. Although very few breed in Canada, an estimated 30 million Dovekie breed in northwest Greenland near the North Water Polynya (Mallory and Fontaine 2004). Many of these birds (an estimated 14 million) migrate north in the spring along shore leads near eastern Baffin Island and the North Water Polynya. The North Water has been the subject of intense ecosystem studies over the past several decades therefore data confidence is relatively high.

2.17 Jones Sound (entrance)

Eastern Jones Sound and Lady Ann Strait form the marine area between southern Ellesmere Island, Coburg Island, and northeastern Devon Island. A recurrent area of open water occurs in the vicinity of Coburg Island. This polynya remains as a separate feature for some months before joining the North Water Polynya in May or June. Freeze-up occurs in late September or early October, beginning in Jones Sound and encompassing Coburg Island by mid- to late October. Open water appears in January, southwest of Coburg Island, and remains all winter. Leads may extend northeast to the North Water Polynya or south towards Lancaster Sound, usually connecting to the latter by April. The North Water Polynya extends south past Coburg Island by mid-May or early June (Smith and Rigby 1981). The recurrent polynya of Eastern Jones Sound provides productive summer habitat for Atlantic Walrus, High Arctic Beluga, Ringed Seals, and is identified as an important maternity area for Polar Bear. Over 500,000 breeding marine birds are found in this area (Mallory and Fontaine 2004). The largest colony of Black-legged Kittiwakes in Nunavut nests here. These cliffs also support Thick-billed Murres and Northern Fulmars. Four colonies of Ivory Gulls (listed under SARA) are located on eastern Devon Island. An estimated 3000 pairs of Northern Fulmars breed on Princess Charlotte Monument beside Coburg Island and an estimated 160,000 Thick-billed Murres nest on Coburg Island. Black Guillemots and Glaucous Gulls nest in the area. This is one of the few known breeding sites for Atlantic Puffins in Nunavut.

2.18 Jones Sound (Hell Gate/Cardigan Strait)

Hell Gate and Cardigan Strait are narrow passages between North Kent, northern Devon, and southwestern Ellesmere islands through which strong currents flow from Norwegian Bay to Jones Sound. A recurrent polynya occurs here because of these strong currents (Smith and Rigby 1981). Freeze-up in the bays and fjords normally occur in September. Throughout October and November, Hell Gate and Cardigan Strait are covered with ice, although the ice

appears to remain mobile. Open water usually reappears in early December, on either side of North Kent Island. From December until July open water remains, with the maximum extent occurring in May, June, and July. In July, breakup normally occurs in Norwegian Bay, and ice flowing south tends to block Hell Gate and Cardigan Strait. As a result the area does not usually become completely ice-free in summer (Smith and Rigby 1981).

Hell Gate/Cardigan Strait is a site of year-round aggregation for approximately 300-500 Atlantic Walrus. Stewart (2008) suggest that this is a distinct population of Walrus. The area is also used in summer by Beluga, Killer Whale, and seals. Several major seabird colonies also occur in the area. The most numerous seabirds present are Black Guillemot, which occurs year-round, with greatest numbers between May and September. Other seabirds include Northern Fulmars, Common Eider and Glaucous Gull.

3.0 WESTERN ARCTIC

The Western Arctic biogeographic region is located in the extreme northwest corner of Canada. For the purpose of discussing and mapping areas of importance within the Western Arctic, two areas were examined: 1) Beaufort Sea LOMA and, 2) Queen Maud Gulf/Dease Strait/Victoria Strait (Figure 7). The Beaufort Sea LOMA encompasses the marine portion of the Inuvialuit Settlement Region (ISR), which actually extends much further north than the biogeographic region (Figure 7). A full description of the Beaufort Sea LOMA ecosystem can be found in Cobb et al. (2008). EBSAs were also previously identified in a series of workshops that were conducted in 2006-2007. For this reason, this report did not evaluate areas from within the Beaufort Sea LOMA sub-region. A further assessment of EBSAs outside of the Beaufort Sea LOMA, using the CBD criteria resulted in an additional 5 EBSAs east of the ISR (Figure 8). Therefore a total of 25 EBSAs are identified in the Western Arctic biogeographic region (Figure 8).

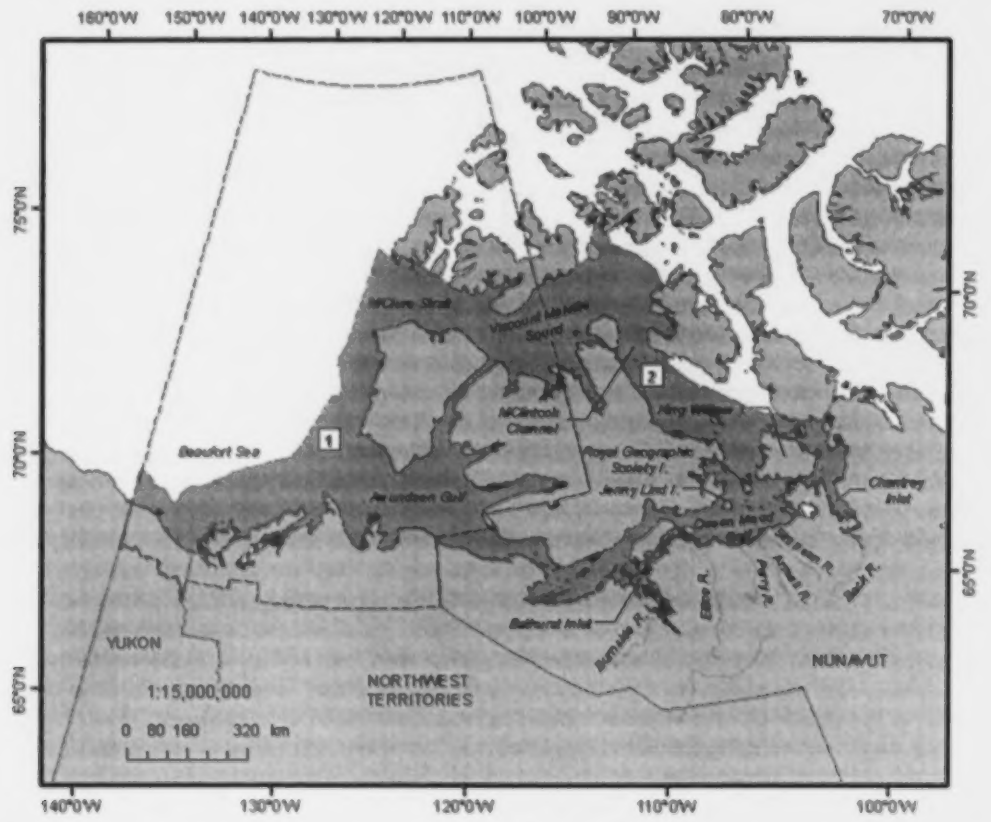

Figure 7. Western Arctic biogeographic region (blue shading) divided into two sub-regions for EBSA evaluation: 1) Beaufort Sea LOMA (identified by the red dashed line) and 2) Queen Maud Gulf/Dease Strait/Victoria Strait.

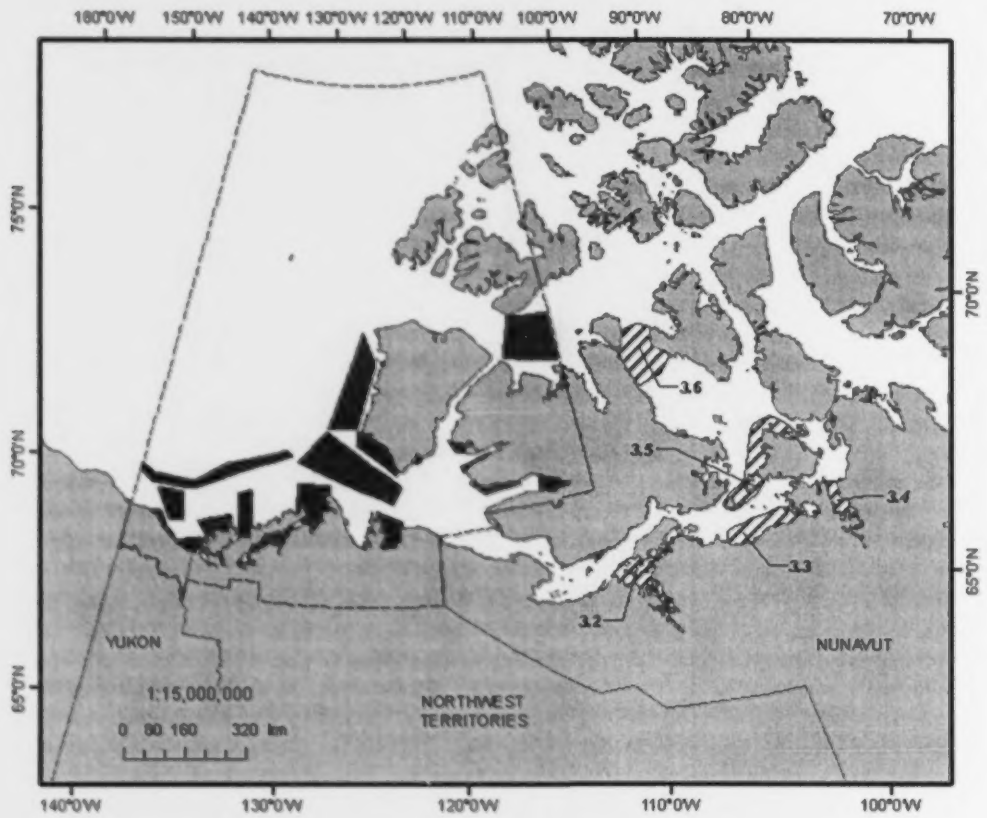

Figure 8. Preliminary EBSA identification results for the Western Arctic biogeographic region. EBSAs identified through a series of workshops conducted in 2004 (Paulic et al. 2009) are identified in red (3.1) within the red dashed boundary of the Beaufort Sea LOMA and the preliminary EBSA identification results for the Queen Maude Gulf/Dease Strait/Victoria Strait sub-region (red hatched lines).

3.1 Beaufort Sea LOMA EBSAs

In order to collect ecological data to identify EBSAs in the Beaufort Sea LOMA two workshops were held, one with the scientific community and one that brought together local community representatives, federal and territorial government departments, and co-management partners. The purpose of these workshops was to: 1) discuss the process of selecting EBSAs; 2) to discuss its application in the Beaufort Sea; and 3) to attempt, for the first time in the Canadian Arctic, to apply the EBSA process. Once the candidate lists were compiled from these initial workshops, a community tour was held in February/March 2007 to give all community members the opportunity to comment on candidate area selection. Each candidate area was then put through the National Evaluation Framework for EBSAs (DFO 2004) which both considers and evaluates each area based on a ranking system against the main dimensions (i.e., uniqueness, aggregation, fitness consequences) and the additional dimensions (i.e., resilience and naturalness) outlined in the Framework. The evaluation process for candidate areas produced 20 EBSAs (Paulic et al. 2009). For details of the evaluation process and results see Paulic et al. (2009).

Queen Maud Gulf/Dease Strait/Victoria Strait

Physical features that define the Queen Maud Gulf marine region include tidal flats and lowlands, sand and gravel beaches, estuaries, and polynyas. Water depth is relatively shallow (<150 m) throughout, and ocean currents move generally from the northwest to the southeast. The ice regime is dominated by a preponderance of first year ice, which remains fast for 7-9 months of the year. The Queen Maud Gulf marine region exhibits more open water during summer and early fall than any other area in the Arctic. Parks Canada undertook a study to identify preliminary representative marine areas for the Queen Maud Gulf marine region, and this is the basis for the identification of important areas for this sub-region (Nunami Stantec Ltd. 2011).

Although little is known about primary productivity and benthic invertebrates, extensive bird use of the marine region would suggest that productivity is high during the summer months. Fifty seven species of fish have been identified here and there is a high concentration of Arctic Char spawning rivers that drain into the marine region. Ringed Seal and Polar Bear are year-round inhabitants, and Bearded Seal are common in summer with some over-wintering. The EBSA criteria were applied to five areas of Queen Maud Gulf.

3.2 Bathurst Inlet

With depths of 100-200 m, and with the influence of the Burnside River, Bathurst Inlet is an important Arctic Char and Ringed Seal summer habitat. Bird colonies are found on small islands near the mouth of the inlet. Based on the occurrence of a polynya there may be productive benthic epifauna communities may exist, however no data is available at this time.

3.3 Queen Maude Gulf (offshore of Queen Maud Gulf Migratory Bird Sanctuary)

The relatively shallow (<100 m) waters along the coast of the Queen Maude Gulf Migratory Bird Sanctuary are heavily influenced by freshwater inputs from four major rivers, the Armak, Ellice, Perry and Simpson rivers. Nutrients that are released from sediments carried to sea from these rivers enhance primary productivity. This area is an important marine feeding and migration area for Arctic Char. Ringed Seal is common throughout the area.

3.4 Chantrey Inlet

Chantrey Inlet is a shallow (<100 m) heavily protected and enclosed ecosystem that is intensely influenced by the Black River, resulting in very low salinities. These conditions present a unique ecosystem that is very productive and utilized by Arctic Char (DFO 2011). The inlet is also identified as prime Ringed Seal summer habitat. The head of Chantrey Inlet is designated a key migratory bird terrestrial habitat site.

3.5 West King William Island

The marine area around West King William Island includes several islands, including Royal Geographic Society and Jenny Lind islands. Fairly strong tidal currents flow around these islands enhancing productivity and may result in local open ocean habitats during winter. Seals and Polar Bear congregate in this area.

3.6 M'Clintock Channel

One of the largest channels in the Canadian Archipelago (274 km long, 210 km wide), M'Clintock is home to one of Canada's Polar Bear populations. It once was an important

denning and feeding area for the M'Clintock Polar Bear population. This stock has been in decline in recent years. Local Inuit have voluntarily reduced their harvest and the population is increasing. Polar Bear feed on the abundant Ringed Seal population that occurs in this mostly ice covered channel.

4.0 ARCTIC BASIN

4.1 Shelf break/permanent ice pack

This unique area of the Arctic is poorly understood, and uninhabited. Unique under-ice communities are supplied nutrient-rich Pacific water from upwellings along the Arctic Basin shelf break. There have been changes in the ice associated fauna since the 1970s and this may be associated with a shift from a multi-year dominated system to a seasonal ice regime. The benthos of the deep abyss within the Arctic Basin is not well understood. For these reasons the entire Arctic Basin is identified as an EBSA (Figure 9).

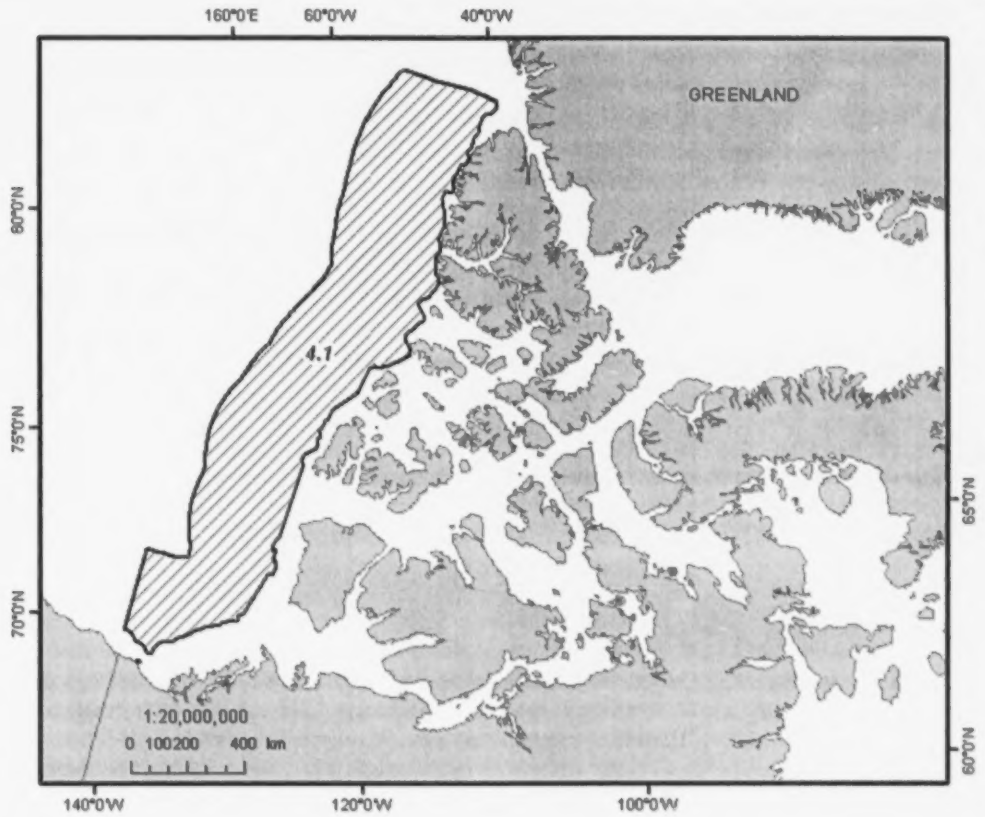

Figure 9. Preliminary EBSA identification results for the Arctic Basin biogeographic region EBSA. The entire biogeographic region was identified as an EBSA.

5.0 ARCTIC ARCHIPELAGO

The multi-year pack-ice provides habitat for distinctive fauna and flora. The extent of the multi-year ice is extremely variable inter-annually and is not a static geographic area but rather an

ever-changing feature that provides critical habitat for many Arctic creatures. Future projections suggest that multi-year polar pack ice will continue to rapidly disappear and be replaced by younger and more seasonal ice. It is expected that the longest remaining portions will be along the northwestern Canadian Archipelago. Two areas are assessed against the EBSA criteria within this biogeographic region (Figure 10).

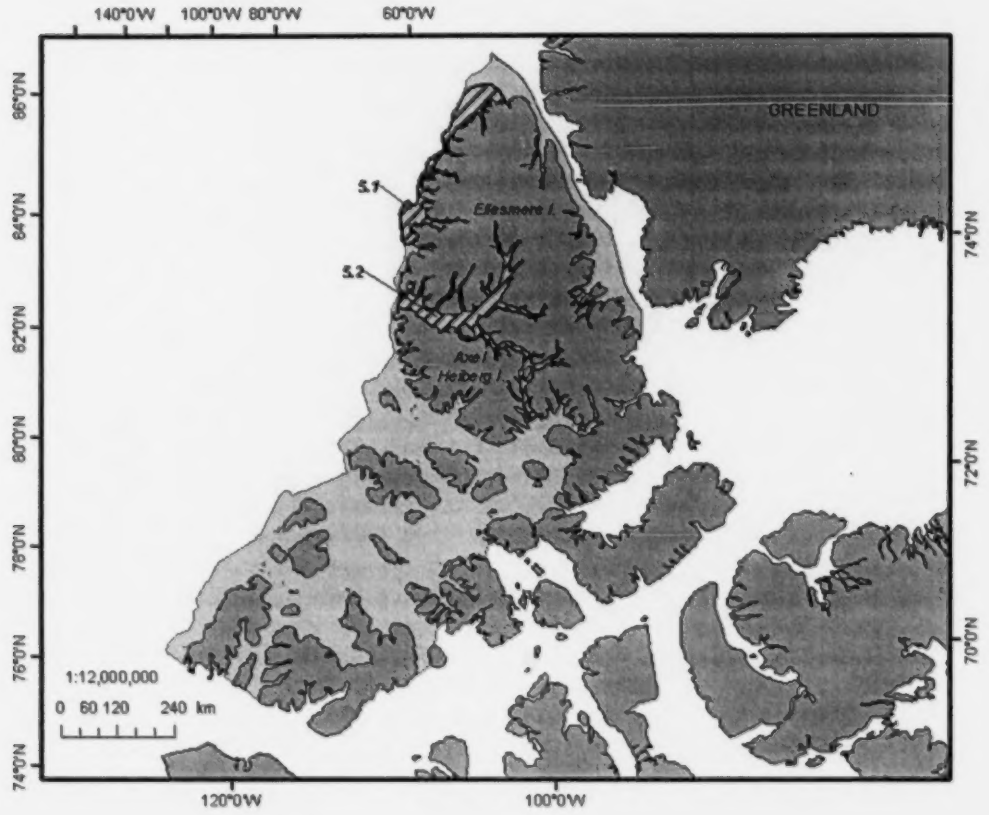

Figure 10. Preliminary EBSA identification results for the Arctic Archipelago biogeographic region (red).

5.1 Ellesmere Island Shelf/Fjords

The largest and most significant glaciers flow from Ellesmere Island into fjords as ice shelves. The areas is relatively shallow (<200 m), and is covered by greater than 90% old year ice. A total absence of biological data makes this area unique.

5.2 Nansen-Eureka-Greely Fjord

The Nansen-Eureka-Greely Fjord marine complex is 400 km long, up to 30 km wide, and 900 m deep, and separates Ellesmere and Axel Heiberg islands. At the outer end of the fjords, shallower sills cut off water transport, and this lack of exchange creates unique water masses. These unique ecosystems are poorly understood.

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APPENDIX 1. Scientific criteria for identifying Ecologically or Biologically Significant Marine Areas (CBD criteria).

Criteria	Definition	Rationale	Examples	Consideration in application
Uniqueness or rarity	Area contains either (i) unique ("the only one of its kind"), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features	□ Irreplaceable □ Loss would mean the probable permanent disappearance of diversity or a feature, or reduction of the diversity at any level.	*Open ocean waters* Sargasso Sea, Taylor column, persistent polynyas. *Deep-sea habitats* endemic communities around submerged atolls; hydrothermal vents; seamounts; pseudo-abyssal depression	□ Risk of biased-view of the perceived uniqueness depending on the information availability □ Scale dependency of features such that unique features at one scale may be typical at another, thus a global and regional perspective must be taken
Special importance for lifehistory stages of species	Areas that are required for a population to survive and thrive.	Various biotic and abiotic conditions coupled with species-specific physiological constraints and preferences tend to make some parts of marine regions more suitable to particular life-stages and functions than other parts.	Area containing: (i) breeding grounds, spawning areas, nursery areas, juvenile habitat or other areas important for life history stages of species; or (ii) habitats of migratory species (feeding, wintering or resting areas, breeding, moulting, migratory routes).	□ Connectivity between life-history stages and linkages between areas: trophic interactions, physical transport, physical oceanography, life history of species □ Sources for information include: e.g., remote sensing, satellite tracking, historical catch and by-catch data, vessel monitoring system (VMS) data. □ Spatial and temporal distribution and/or aggregation of the species.
Importance for threatened, endangered or declining species and/or habitats	Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species.	To ensure the restoration and recovery of such species and habitats.	Areas critical for threatened, endangered or declining species and/or habitats, containing (i) breeding grounds, spawning areas, nursery areas, juvenile habitat or other areas important for life history stages of species; or (ii) habitats of migratory species (feeding, wintering or resting areas, breeding, moulting, migratory routes).	□ Includes species with very large geographic ranges. □ In many cases recovery will require reestablishment of the species in areas of its historic range. □ Sources for information include: e.g., remote sensing, satellite tracking, historical catch and by-catch data, vessel monitoring system (VMS) data.

Criteria	Definition	Rationale	Examples	Consideration in application
Vulnerability, fragility,sensitivity, or slow recovery	Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.	The criteria indicate the degree of risk that will be incurred if human activities or natural events in the area or component cannot be managed effectively, or are pursued at an unsustainable rate.	*Vulnerability of species* □ Inferred from the history of how species or populations in other similar areas responded to perturbations. □ Species of low fecundity, slow growth, long time to sexual maturity, longevity (e.g., sharks, etc). □ Species with structures providing biogenic habitats, such as deep-water corals, sponges and bryozoans; deep-water species. *Vulnerability of habitats* □ Ice-covered areas susceptible to ship-based pollution. □ Ocean acidification can make deep-sea habitats more vulnerable to others, and increase susceptibility to human induced changes.	□ Interactions between vulnerability to human impacts and natural events □ Existing definition emphasizes site specific ideas and requires consideration for highly mobile species □ Criteria can be used both in its own right and in conjunction with other criteria.
Biological productivity	Area containing species, populations or communities with comparatively higher natural biological productivity.	Important role in fuelling ecosystems and increasing the growth rates of organisms and their capacity for reproduction	□ Frontal areas □ Upwellings □ Hydrothermal vents □ Seamounts	□ Can be measured as the rate of growth of marine organisms and their populations, either through the fixation of inorganic carbon by photosynthesis, chemosynthesis, or through the ingestion of prey, dissolved organic matter or particulate organic matter □ Can be inferred from remote-sensed products, e.g., ocean colour or process-based models □ Time-series fisheries data can be used, but caution is required

Criteria	Definition	Rationale	Examples	Consideration in application
Biological diversity	Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.	Important for evolution and maintaining the resilience of marine species and ecosystems	□ Seamounts □ Fronts and convergence zones □ Cold coral communities □ Deep-water sponge communities	□ Diversity needs to be seen in relation to the surrounding environment □ Diversity indices are indifferent to species substitutions □ Diversity indices are indifferent to which species may be contributing to the value of the index, and hence would not pick up areas important to species of special concern, such as endangered species □ Can be inferred from habitat heterogeneity or diversity as a surrogate for species diversity in areas where biodiversity has not been sampled intensively.
Naturalness	Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.	□ To protect areas with near natural structure, processes and functions □ To maintain these areas as reference sites □ To safeguard and enhance ecosystem resilience	Most ecosystems and habitats have examples with varying levels of naturalness, and the intent is that the more natural examples should be selected.	□ Priority should be given to areas having a low level of disturbance relative to their surroundings □ In areas where no natural areas remain, areas that have successfully recovered, including reestablishment of species, should be considered. □ Criteria can be used both in their own right and in conjunction with other criteria.

APPENDIX 2. EBSA criteria evaluation matrix using CBD criteria described in Appendix 1 and abbreviations in Appendix 3.

Region	EBSA	Uniqueness/ Rarity			Importance for Life History Stages			Importance for threatened, endangered or declining species & habitats			Vulnerable, fragile, sensitive or slow to recover			Biol. Prod.			Divers. of habitat spp.			Nat.			Score
		L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	
Hudson Bay Complex																							
Foxe Basin	See DFO (2010a)																						
Hudson Bay	Repulse Bay/ Frozen Strait (1.4)		BHW PB BW W SB AC KW	NW		BW	BHW NW SB W SB AC BS		BHW NW				BHW NW			X		X			X		4.75
	South-ampton Island (1.5)			SB			SB PB BHW W		BHW				BHW W			X			X		X		5.50
	West Coast/ Whale Cove (1.6)		KB			BW KW AC							KB	X				X			X		2.00
	Western Hudson Bay (1.7)			BW PB			BW PB	PB	BW			BW	PB	X				X		X			3.50
	James Bay (1.8)			BW W EGR		BW AF	W SB PB		W	BW			W EGR BW		X				X	X			5.25
	Belcher Islands (1.9)			BW EGR		PB	BW W SB		W	BW			BW W EGR			X			X		X		6.25
Hudson Strait	West and Central Hudson Strait (1.10)	KW		BHW W NW			BHW BW NW KW W		W BHW NW BW		BHW NW		BW		X				X		X		4.75
	Eastern Hudson Strait (1.11)			BHW BW W NW DWC		PS	BHW BW W NW		W BHW NW		BHW NW		BW DWC			X			X		X		5.50
	Ungava Bay (1.12)			DWC BW	SB PB		DWC BW			BW			DWC BW	X				X			X		4.50

Region	EBSA	Uniqueness/ Rarity			Importance for Life History Stages			Importance for threatened, endangered or declining species & habitats			Vulnerable, fragile, sensitive or slow to recover			Biol. Prod.			Divers. of habitat spp.			Nat.			Score
		L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	
Eastern Arctic																							
Lancaster Sound/ Barrow Strait Complex	Eclipse Sound/ Navy Board Inlet (2.1)		NW		SB		NW HS		NW				NW		X			X			X		3.25
	Admiralty Inlet (2.2)		NW		MF	BHW	NW HS		NW				NW		X			X			X		3.25
	Prince Regent Inlet/ Creswell Bay (2.3)	BHW		NW		SB	BHW NW BW AC		BHW NW BW				BHW NW BW			X			X			X	6.25
	Gulf of Boothia/ Pelly Bay/ Committee Bay (2.4)		NW BW	BHW	BW	NW	BHW		BHW NW BW				BHW NW		X			X			X		4.00
	Peel Sound/ Barrow Strait (2.5)			NW			NW BW		NW				NW BW			X		X				X	5.50
	Lancaster Sound (2.6)			BHW NW BW W PB			BHW NW BW W PB BI		BHW BW W				BHW NW PB W			X			X			X	6.25
	Pelly Strait/ Wellington Channel (2.7)			W SB			W SB		W	SB			W SB		X			X				X	5.50
Davis Strait/ Baffin Bay	Southern Davis Strait (2.8)	MF		NW DWC DWS HS	MF		NW DWC DWS HS	MF	NW				NW DWC DWS			X			X		X		5.50
	Frobisher Bay (2.9)		BW BHW W				BW BHW W		BW BHW W				BW BHW W		X			X			X		3.25

Region	EBSA	Uniqueness/ Rarity			Importance for Life History Stages			Importance for threatened, endangered or declining species & habitats			Vulnerable, fragile, sensitive or slow to recover			Biol. Prod.			Divers. of habitat spp.			Nat.			Score
		L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	
Davis Strait/ Baffin Bay	Inner Cumberland Sound (2.10)	MF		BW	MF		BW		BW				BW		X			X			X		4.00
	Outer Cumberland Sound (2.11)		BHW W	BW			BW BHW W		BW BHW W				BW BHW W		X			X				X	4.75
	Northern Davis Strait (2.12)	MF		NW DWC DWS			NW DWC DWS MF		NW				NW DWC DWS			X			X		X		5.50
	Baffin Bay Shelf Break (2.13)			NW DWC DWS			MF DWC DWS	MF					DWC DWS			X		X				X	5.25
	Southern Baffin Bay (2.14)	MF		NW DWC DWS			NW DWC DWS MF	MF	NW				NW DWC DWS			X			X		X		4.00
	E. Baffin Island coastline (2.15)	W	NW BW	BHW		W	BHW NW BW		NW BHW W				BHW NW BW		X				X		X		4.75
	North Water Polynya (2.16)			BW BHW W SB			BW BHW W SB		BW BHW W				BHW BW W			X			X			X	6.25
	Jones Sound entrance (2.17)	W,B W		SB			W BW SB		BW W	SB			W BW SB			X		X			X		5.50
	Jones Sound/ Hell's Gate (2.18)			W			W SB		W				W		X			X				X	4.75
Western Arctic																							
Beaufort Sea	See Paulic et al. (2009)																						

Region	EBSA	Uniqueness/ Rarity			Importance for Life History Stages			Importance for threatened, endangered or declining species & habitats			Vulnerable, fragile, sensitive or slow to recover			Biol. Prod.			Divers. of habitat spp.			Nat.			Score
		L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	
Coronation Gulf/ Queen Maud Gulf/Dease Strait	Bathurst Inlet (3.2)					RS MF	AC SB							X				X			X		1.50
	QMG Bird Sanctuary waters (3.3)						AC							X				X			X		1.50
	Chantrey Inlet (3.4)						AC RS							X				X			X		1.50
	West King William Island (3.5)						PB RS SB					PB			X				X		X		2.75
	M'Clintock Channel (3.6)						PB	PB				PB			X				X			X	2.50
Arctic Basin																							
	Shelf Break/ Permanent Ice Pack (4.1)			UIF			UIF			UIF			UIF			X			X			X	6.25
Arctic Archipelago																							
	Nansen-Eureka-Greely Fjord (5.1)			UIF			PB RS UIF	RS		PB UIF			PB UIF		X			X				X	5.50
	Ellesmere Island Shelf/Fjord (5.2)			UIF			UIF			UIF			UIF	X			X					X	5.00

APPENDIX 3. List of Abbreviations used for species and communities identified in the EBSA evaluation matrix (Appendix 2).

AC – Arctic Char

AF – Anadromous Fish

BHW – Bowhead

BI – Benthic Invertebrates

BW – Beluga

DWC – Deepwater Coral

DWS – Deepwater Sponges

EGR – Eelgrass

HS – Harp Seal

KB – Kelp Beds

KW – Killer Whales

MF – Marine Fish

NW – Narwhal

PB – Polar Bear

PS – *Pandalus* Shrimp

RS – Ringed Seal

SB – Seabirds

UIF – Under-ice Fauna

W – Walrus